

such a position that it remains firm throughout the full range of movement and thus contributes to stability in all positions. Another point is that the only clinical sign of a satisfactory repair is the absence of a 'drawer' sign.

To summarize: In the majority of cases, isolated rupture of the anterior cruciate ligament produces little disability and does not call for treatment other than the development of the quadriceps muscle, but in the small proportion of cases where there is persistent and troublesome instability because of this lesion, I consider this repair has a useful place.

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Experiences with Intravenous Regional Anæsthesia

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Almost a century has passed since local anæsthetics were first injected intravascularly. According to Allen (1914) intra-arterial injections of cocaine were carried out in a frog by Alms in 1866 and in man later by Appel and Goyanes. In both cases analgesia of the extremity was produced. It was not until 1908 that Bier used what he described as 'venous anæsthesia' in 134 cases with no adverse side-effects. Although several series were reported during 1909 (Page & MacDonald, Hitzrot, Hartel, Catz), with the exception of Adams (1944) and Lee (1959) the method is given little attention in anæsthetic textbooks. Several series of cases have been published during 1963 (Bell *et al.*, Holmes) and 1964 (Adams *et al.*, Cox), each varying the method slightly. Many surgeons and anæsthetists still seem unfamiliar with the procedure and when it may be applied, particularly in orthopædic and traumatic surgery.

The present series is intended to show the convenience, simplicity, safety and efficiency of the method, and the manner in which it can be used with good effect for major and minor acute, traumatic or elective surgery on the extremities.

Method: After the surgeon has examined the patient to check on which limb the operation is to be performed, the anæsthetist explains to the patient exactly what is going to be done and what he can expect to feel. It is important to gain the patient's confidence and to reassure him throughout the procedure that all is going according to plan. If this is done, pre-operative sedation is rarely necessary.

Several turns of orthopædic wool are wrapped round the upper arm or calf and a sphygmomanometer cuff is placed over the wool and is secured in position with a cotton bandage. The wool is necessary to reduce any unpleasant sensations due to pressure from the tourniquet and the bandage is used to ensure that the cuff does not become undone during the operation. The blood pressure is then taken and the cuff left at a point just above the diastolic pressure to produce venous engorgement and facilitate the insertion of an indwelling needle into a vein: after preliminary infiltration of the skin with 0.5% lignocaine, a Mitchell needle is inserted into any convenient vein that does not interfere with the operation site; the needle should be washed through, to prevent clotting, and is then secured to the skin with strapping. (In this series 2 ml of 0.5% lignocaine was used to flush the needle through, providing a test for hypersensitivity to the drug before the main dose is given.) After elevation of the limb for several minutes, an Esmarch rubber bandage is used to exsanguinate the limb and the cuff is inflated to 50 mm above the systolic pressure. The bandage is omitted when the condition is a painful one, such as a fracture. Care must be taken not to disturb the position of the Mitchell needle during this exsanguination manoeuvre. The Esmarch bandage is then removed and 40 ml of a 0.5% solution of plain lignocaine is injected intravenously using the Mitchell needle. The skin begins to take on a blotchy purplish appearance and paræsthesiæ are soon felt by the patient. Within five to seven minutes anæsthesia to pain is complete although other sensation, such as touch, may remain for a time. This period may be shortened slightly if the patient clenches and unclenches his fist several times; in larger limbs another 5–10 ml of the solution may have to be injected.

The operation may begin as soon as sensation

to pin-prick is blunted and, ten minutes after the injection, complete anæsthesia including muscular paralysis is present. When the operation is over, the tourniquet is released as soon as bandages or splints have been applied: the patient notices a feeling of warmth immediately and paræsthesiæ are felt after a few minutes; muscle power returns rapidly and sensation is virtually normal after ten minutes. In most cases post-operative pain seems to be greatly reduced after using this method.

The absence of a post-operative recovery phase means that the operations may be performed on out-patients, resulting in a considerable saving of in-patient theatre time and valuable bed-space.

Selection of patients: The patients in this series were drawn from those attending the Orthopædic Out-patient Clinic and the Casualty Department: all patients with a suitable lesion of the forearm, hand, lower leg or foot who did not object to a local anæsthetic were treated by this method; the only exceptions were the occasional patient, usually female, with cold, bluish 'veinless' extremities and the extremely apprehensive patient, with whom all types of local anæsthesia are unsuitable, which was emphasized in one case when the patient began to overbreathe whilst the cuff was being wrapped round her arm (prior to any injection at all), resulting in a state of alkalotic tetany necessitating inhalation of oxygen and carbon dioxide.

Operations: The results of the first 134 operations done in this way are presented in this series: 40 were emergencies and 94 were routine (Table 1). There were 36 men and 98 women, their ages varying from 13 (3 cases) to 88 years (18 cases were 80 years or older.) The time taken to perform the operation varied from five minutes to one hour and twenty minutes – a wide range which made it possible to consider this method for almost any condition, from a simple trigger

finger release to a plating of both forearm bones. The variety of operations performed may be seen from Table 1.

Results: Of the 134 cases forming the series, 130 were classified as satisfactory. This meant that the patient suffered no discomfort during the operation and had no unpleasant after-effects. Four cases had to be labelled unsatisfactory, insufficient analgesia being produced. These occurred early in the series and were found to be due to technical errors such as: (1) Failure to wash through the Mitchell needle when placed in the vein, resulting in blockage of the needle. (2) Dislodgement of Mitchell needle by Esmarch bandage. (3) Slipping of blood-pressure cuff, causing a leak of lignocaine into the general circulation. (4) An unexplained failure.

Complications: (1) Superficial venous thrombosis at the site of the injection (3 cases). This was due to lignocaine containing chlor-cresol as a preservative and has since been completely abolished by using plain lignocaine. (2) Slight dizziness when the tourniquet was released (3 cases). (3) Hæmatoma formation after puncture of fragile veins (2 cases).

It was surprising to find that very few patients objected to the pressure of the cuff if carefully positioned as previously described. We have not found the double cuff as described by Hoyle (1964) to be necessary, nor have we infiltrated the skin proximal to the tourniquet (Lee 1959). Most patients expressed their pleasure with the method, saying it was preferable to being asleep as the post-operative phase entailed no discomfort whatever. Only 2 patients objected to the method and stated they would have preferred a general anæsthetic.

Mode of action: It is not possible to elucidate the exact manner in which this method produces analgesia. Attempts to label lignocaine with dyes,

Table 1

Experiences with intravenous regional anæsthesia in 134 cases

<i>Emergency cases</i>		<i>Routine cases</i>	
Reduction Colles' fracture	22	Release trigger fingers	23
Reduction other fractures	7	Decompression median nerve	27
Reduction dislocated elbow	1	Excision ganglion wrist and foot	20
Plating fractured radius and ulna	1	Amputation fingers or toes	4
Debridement gunshot wound	1	Excision olecranon bursæ	3
Suture lacerations	1	Removal wire from bones	4
Incision abscess	1	Excision chondromata, exostoses, &c.	9
Repair cut tendons	3	De Quervain's tenosynovitis	2
Skin graft	1	Dupuytren's contracture	1
Amputation fingers	2	Arthrodesis of toe	1
Total cases	40	Total cases	94

radiopaque or radioactive substances are all unsuccessful since it is difficult to modify the compound without changing its important local anæsthetic property.

We have noticed that the site of the injection does not alter the time taken to produce anæsthesia or its efficiency. We presume that the mechanical pressure of the solution, injected into a relatively empty venous tree, ensures the even distribution of the lignocaine throughout the venous system of the limb, including the nerves, thereby producing its anæsthesia.

Release of the tourniquet produces gradual distribution throughout the body of the then extremely dilute lignocaine solution. This results in a rapid return of sensation with the absence of any toxic effects.

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